Public Investment, Growth and Debt Sustainability

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Abstract

This paper analyses two joint problems worrying in some euro area countries: the slow rate of economic growth and the high public debt level. Economic growth has remained low even after the end of the long economic crisis, also because an adequate fiscal stimulus has been missing. In particular, public investment is still well below (as a percentage of GDP) the pre-crisis levels. In this context, a feasible solution is provided by the realization of a large investment program at the EU (or at least at the Eurozone) level. Such a program could be easily market-financed. This plan could have significant positive effects on current and medium term GDP growth. Moreover, in the paper it is shown – through numerical simulations – how important stabilizing effects might be obtained on both public debt and interest rates. Thus such a plan not only will not augment national public debts but it will indirectly help to reduce the debt service on existing sovereign bonds. By raising economic growth and improving social conditions, the proposed plan could also favour the restoration of a pro-European sentiment, which lately has faded away in many EU countries because of the growth-depressing fiscal austerity policies.

1. Introduction

This paper introduces a framework for the analysis of public debt stability that refers to the approach proposed initially by Domar (1944) and Pasinetti (1997), and extends it in order to consider, together with the role of fiscal policy, interest rate and of GDP growth in stabilizing public debt, also the role played by agents' heterogeneous expectations relative to the variables mentioned above and determining the public debt sustainability equation.

Within that framework it will be possible to analyse the likely effects of the adoption of a market-financed and growth-enhancing investment plan, which would have the merit of increasing GDP growth and therefore of stabilizing and reducing the public debt-to-GDP ratio.

Marelli and Signorelli (2017a) suggest that in order to assure the survival of the euro area it will be necessary to carry out some crucial and unavoidable reforms; moreover, it would be wise to set up shortly a quantitatively significant (at least 5% of Eurozone's GDP, to be realized within three years), market financed investment plan in the euro area. The idea becomes even more relevant in the presence of very low interest rates on debt – such as the ones reached in the Eurozone – suggesting that it is difficult not to believe that investments may not be capable to produce a net positive reward.

This paper nests the proposal mentioned above in the framework for public debt stability considered by Della Posta (2018). He argues that fiscal austerity had a double negative effect on both interest rate (increasing it) and GDP growth (decreasing it). A program of market-financed investment plan area would have opposite results.

Such a market-financed investment plan, whose debt service could be paid by individual States of the Eurozone), would play an indirect role in the solvency condition even for domestic public debts, thanks to the reduction effect on the interest rate and on the increasing effect on GDP growth.

The paper is structured as follows. Section 2 illustrates the deeply negative economic and social impact of the long crisis on aggregate demand, and especially on investment; then it discusses the feasibility of an euro area investment plan. Section 3 presents the model we are going to use in order to discuss the effects of such a plan on public debt sustainability. In particular, based on some previous results relative to the negative relationship between fiscal austerity and GDP growth and to the positive relationship of the former with interest rates, it introduces the "multiplier effect" and the "real wealth effect" of an investment plan on GDP growth and the "sustainability effect" on interest rates. An additional benefit would be on the pro-European sentiment of European citizens and then

on the feasibility of further steps towards European integration. Section 4 proposes some concluding remarks.

2. The long crisis, austerity and the need for a fiscal stimulus through an investment plan

A double crisis hurt European countries – in particular some Eurozone's countries located in the periphery – over the last ten years: (i) the world financial crisis originated in the United States and causing the Great Recession (2008-09); (ii) the sovereign debt crisis contributing to a second recession (2010-13) and a subsequent weak recovery. Although in 2018 the real product of most Eurozone countries returned, at least, to pre-crisis levels (except for Greece and Italy), the rate of growth has generally been much lower compared to the United States, not to mention emerging countries (see Table A1 in the Appendix).

The long crisis was also caused by the uncertain, delayed and – at least in some cases – wrong responses by the EU institutions, an approach that has been dubbed "*too little too late*".[1] Already in the early stage of the sovereign debt crisis (2010-11) the reaction to the shock in Greece and other peripheral countries was cumbersome, also because crisis management tools were not readily available and there were different opinions on how to tackle the crisis. It took some time to introduce the "bail out" funds (the provisional *European Financial Stability Facility* and then the *European Stability Mechanism*); then, the early decision on the opposite "private sector involvement" put financial markets under stress, showing that the "risk-sharing" assumption characterizing the first decade of euro's life was false. Furthermore, a new risk – additional to the one relative to default - made its appearance: the "redenomination risk", i.e. the possibility that a country could abandon the euro or that the whole monetary construction could disintegrate. This is why the spreads on the interest rate of sovereign bonds of peripheral countries increased over the years 2010-12, precisely when fiscal austerity policies started being adopted (see Figure A1).

The situation seemed to improve only when monetary policy became progressively accommodative – under Draghi's presidency – with interest rates reaching the zero level (or becoming even negative in the case of overnight deposits) and with the adoption of several unconventional measures. In particular, the OMT (*Outright Monetary Transactions*) plan, adopted in 2012, was fundamental in reducing the spreads on sovereign bonds of peripheral countries and "saving the euro", as promised by Draghi in a famous speech (in July 2012); then, the QE

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[1] As for a discussion of the wrong European policies see also Marelli and Signorelli (2017b).

(*Quantitative Easing*), introduced in 2015, tried to increase the inflation rate (close to zero in 2015-16) and help the economic recovery. It has been President Draghi's ability to make possible the approval of such measures, despite both the opposition of the German representative in the ECB's Council (at least in some occasions) and the statutory limits; for example, the impossibility for the ECB to act explicitly as "lender of last resort" for the States (a key flaw of the monetary union, according to De Grauwe 2013).

The crucial problem was that monetary policy did not find any support from fiscal policy.[2] By reversing the causality link, the EU institutions interpreted the rise in public deficits and debts as the main cause of the crisis, while it was the most evident consequence. In fact, the original financial imbalances were, also in Europe, in the private sector, with very high private debt over GDP ratios (in the United Kingdom, Ireland, Spain, etc.) and many private banks (in Germany, France, etc.) exposed to the debts of peripheral countries. In this situation, during crisis periods, sudden capital outflows may happen, causing imbalances in the Eurozone's payment system (Acocella, 2016, Beker and Moro, 2016).

The confusion made by the EU institutions – fuelled by the ideologically-driven presumption that the Greek fiscal cheating had provided the uncontroversial evidence that the fear for fiscal instability that had been characterising the process of European monetary integration from the very beginning was fully justified - led them to adopt *austerity* policies, not only imposed on the countries assisted by the "troika", but on all countries of the euro area, through the reinforced fiscal rules: the Stability and Growth Pact, the Fiscal Compact, the Six Pack, the Two Pack, etc. Not surprisingly, the reduction of public expenditures, in particular investments, together with the increase (in some cases) of taxation, implemented in the middle of a severe economic crisis, resulted in pro-cyclical policies, thus aggravating the recession or weakening the recovery (Blyth, 2015, Holland, 2016). The mistake was also caused by wrong estimates of the fiscal multipliers. These are not generally low, as assumed some years ago, but – especially during recessions and when interest rates reach the zero-lower bound – may be significantly greater than one (as explicitly recognized by Blanchard and Leigh, 2013 and IMF, 2012). The problem is even worse when several countries consolidate at the same time. In any case, during the crisis years the traditional Keynesian effects dominated over possible – but unlikely, considering the existing situation – "non-Keynesian effects" of fiscal adjustment (Ricardian equivalence, credibility effect on interest rates, positive expectations deriving from

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[2] It should be recalled that in a similar zero lower bound (or liquidity trap) situation, J.M. Keynes observed that monetary policy was ineffective and argued in favor of the adoption of expansionary fiscal policies.

improved public accounts). As a matter of fact, the so-called "expansionary austerity" has been an illusion.[3]

The paradox is that austerity measures produced adverse results even for the public accounts and the sustainability of public debt. Such measures were, in fact, "*self-defeating*" – as initially declared by Krugman (2010) – because the fall in the denominator of the relevant ratios (the GDP) was larger than the reduction in the numerator. Rather than in the deficit/GDP ratios, that tended to decrease below the required 3% threshold, although with different pace in the various countries (see Table A2), the self-defeating effect is most evident in the debt/GDP ratios, that continued to increase until recently in most countries (Table A2); only Germany was able to exhibit a significantly decreasing trend. Notice also that it is extremely difficult, on economic and social grounds, to increase the primary balances during recessions or slow economic recoveries, since at least the automatic stabilizers should be allowed to act. Moreover, as already recalled above, in the initial stage of the crisis public expenditures increased in many countries because of the public bail out of private banks.

The point at stake, here, is not the austerity approach in general, because financial markets themselves might well punish an opportunistic and inappropriate behaviour by national governments (especially in highly-indebted countries), independently from the position taken by the EU Commission. The critique refers to how has austerity been imposed, namely without considering that it was totally inappropriate given the severe economic crisis that was hitting Europe (austerity policies are also severely criticized, among others, by Boyer, 2012, Callinicos, 2012 and Konzelmann, 2014).

Moreover, financial markets may well attach more importance to the growth perspectives of a country than to the fulfilment of a numerical requirement (such as a balanced budget or the Stability Pact's 3% ceiling). Thus, interest rates may remain high, thereby exacerbating the self-defeating effect. Furthermore, the reduction of the debt-to-GDP ratio depends on the growth of *nominal* GDP. Hence, the deflationary situation recently experienced makes more difficult the fiscal adjustment.

Contrary to the recent Eurozone's experience, high GDP growth might well be a solution to the debt sustainability problems (see Della Posta, 2018 for a deeper analysis of the role played by GDP growth in the euro area crisis). Some previous historical examples - including the European countries after WW2, or the USA under the Clinton administration, after the deficit produced by the

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[3] Even in the peripheral countries where GDP growth has accelerated in the last three or four years – such as Ireland, Spain and more recently Portugal – the recession could have been less deep and social pain less dreadful with a more accommodative fiscal policy.

previous Reagan administration - also make clear that growth, rather than fiscal austerity, helped redressing fiscal balances. Moreover, as reported by Collignon (2012), Bohn (1995, 2008) shows that in the USA, over the last 200 years, the public debt-to-GDP ratio has been kept on a non-explosive path thanks to the average GDP growth being larger than the average interest rate on it. This is also in line with what argued by Domar: "the problem of the debt burden [is] essentially a problem of achieving a growing national income" (Domar, 1944, p. 822).[4] Empirical evidence of the stabilizing role of fiscal policies on the public debt-to-GDP ratio is found by McCausland and Theodossiou (2016) who consider episodes of fiscal contractions in 11 OECD countries over the period 1881-2011, finding evidence that the public deb-to-GDP ratio deteriorated rather than improved.

Increasing GDP growth may require a domestic stimulus on the aggregate demand coming from fiscal policy and/or the introduction of structural reforms on the supply side. In the euro area, only the second option has been followed,[5] but it could be questioned whether a long term response on the supply side[6] may be appropriate when the shock hitting the economy in the short term is relative to the demand side. Moreover, even in a long run perspective, neoliberal approaches based on liberalisations and privatisations cannot be the sole solution, since a more ambitious package of structural policies is needed, based on investments (in infrastructures, new technologies, R&D, human capital), also to support an anaemic productivity growth; as well as on a new "industrial policy" (see Cappellin *et al.*, 2017, Mazzucato, 2014).

In any case, the fact that in several European countries the key macroeconomic problem has been a lack of aggregate demand is confirmed by the evidence that many of them have suffered for a long period because of large and persistent output gaps. Estimations of the potential growth rates, output gaps, and cyclically adjusted government accounts are presented and discussed in several European Commission reports (e.g. European Commission, 2014). Output gaps characterized many countries still in 2016, some years after the start of the recoveries of the economies (not only in the peripheral countries but also in France and other countries). Additionally, in recent years some critiques have been raised against the model and methodology used by the EU Commission for its calculations of output gaps, which tend to underestimate the magnitude of the economic cycle by

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[4] A different view, however, is proposed by Reinhart *et al.* (2015), who argue instead that the main role in favoring the public debt-to-GDP reduction has been played by low, and quite often even negative, real interest rates.

[5] It is certainly understandable that expanding fiscal policy in the middle of a crisis that was considered as driven by a fiscal divergence (as in the case of the original Greek shock) might not appear as a reasonable solution. But in most Eurozone countries this has not been the case, as we have argued above.

[6] According to Eggertsson et al. (2014), structural reforms may even have a negative impact if they stimulate deflationary expectations.

assuming pronounced hysteresis effects.[7] Notice that this procedure produces wrong policy implications by attaching too much importance to structural policies with respect to aggregate demand management. Moreover, an underestimation of potential GDP produces a too low output gap, which in turn implies too high structural deficits, thus requiring an excessive budgetary adjustment (under the Fiscal Compact rules).

In many Eurozone countries, the repeated recessions and weak recoveries had also dramatic effects on labour markets, especially on young people. As regards total unemployment rates (UR), several countries reached two-digit rates and UR have been particularly persistent; even in countries where they recently decreased, they are generally higher compared to pre-crisis levels. Of course, the longer and deeper the stagnation is, the more profound is also the impact on potential output: cyclical unemployment is likely to become structural and persistent. Thus, fiscal stimuli on aggregate demand should be necessarily accompanied by structural policies, for instance active labour market policies to fight structural unemployment.

In any case, the adverse cyclical conditions had also profound effects on living conditions, social situations and even political contexts (as we shall discuss also in the conclusions to this paper). In particular, the rising inequalities, also driven by an unregulated globalization processes (see Fadda and Tridico, 2017), led to a growing opposition, manifested not always in social conflicts, but rather in political movements supporting populist or nationalist approaches.

As an alternative to the generalised fiscal stimulus suggested by Eichengreen (2012), Germany should play the role of engine of Europe, something that, however, given her high propensity to export, she does not seem to consider doing (while the USA have been the engine of the world in the past, thereby accepting to experience large current account deficits). As a matter of fact, the crisis has also been aggravated by a lack of macroeconomic coordination: tight austerity has been imposed on debtor (Southern) countries while creditor (Northern) countries continued to follow balanced-budget policies, with huge trade surpluses in the case of Germany (see De Grauwe, 2013, Heise, 2015).

Paradoxically, excluding 2009 i.e. the year of a large decline in world trade, in more recent years it was not external demand that caused the unsatisfactory economic growth in peripheral countries, despite the deep imbalances between the German surpluses and the current account deficits in the periphery. As a matter of fact, in recent years, exports have generally improved also in

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[7] See Cottarelli et al. (2014). For example, over the years 2008-2013 about 70% of the Eurozone's fall in GDP was considered as structural (i.e. connected to a loss of potential output) and only 30% as cyclical, an estimate that seems largely unrealistic.

the Eurozone's periphery, also thanks to the "internal devaluations", i.e. reductions in (relative) prices and wages, that of course contributed to the deterioration in social conditions, but were a substitute for explicit devaluations (not possible within the euro area). We also notice that for low-competitive countries it would be preferable to reduce unit labour costs by increasing productivity (which requires more investments and R&D expenditures), rather than by cutting wages (that could also cause deflationary pressures). In any case, trade balances lastly became positive in some of the peripheral countries.

The real problems, on the contrary, concerned internal demand: consumption and, even more significantly, investment (together with public expenditure because of the mentioned austerity). Over the crisis period, total investment has collapsed by about one third in the peripheral countries of the Eurozone, and they are still much lower than the 2008 levels. What is unjustifiable is that even public investment has been deeply cut, thereby exacerbating the pro-cyclical behaviour of fiscal policies (see Table A4).

A reasonable way out suggested in this paper is the adoption of a large public investment plan. Such a plan can have a double economic benefit. In the short run, it supports aggregate demand, production and employment; through multiplier and expectation effects, it stimulates also private investment and consumption. A second economic benefit can be obtained in the long run, since it raises productive capacities, potential output and productivity[8]; thus it will be self-financed, thanks to the increase of future incomes and tax receipts (this is the motivation underlying the "golden rule" proposal for the balance of public budgets).

It is hard to believe that the current very favourable monetary conditions – zero interest rates (or around 2% interest rate on the long term sovereign debt of peripheral countries) – do not allow policymakers to find investment projects whose rate of return exceeds the cost of financing (see also Micossi, 2016, De Grauwe, 2017). We do not necessarily refer here to huge infrastructure projects or public works, that are often characterized by long planning and implementation times as well as by budgets continuously revised upward. We rather mean a variety of "micro-investments" spread over the territory such as: environment protection, safeguard of the territory, anti-seismic interventions, energy efficiency, social housing, hospitals and schools building and renovation, local transport, tourist infrastructures, and many others.

The Juncker plan introduced in 2015 was an interesting move in this direction, but it has been too timid as for the resources allocated and too slow in its implementation. A much more powerful

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[8] According to De Grauwe and Ji (2016), an investment plan has a greater growth impact compared to structural reforms.

plan, to realize immediately, would be necessary. Marelli and Signorelli (2017a) proposed a plan of new investments additional to the current national ones[9], for an amount equivalent to 5% of Eurozone's GDP (i.e. worth about 500 billion euros), to be realized within three years (with a possible extension to five years). It could be financed either by Eurobonds or through a major involvement of the European Investment Bank, that might issue bonds to be purchased either by the market or, on the secondary market, by the ECB itself (such purchases were partially already made within the QE program). The direct involvement of the EU budget is at present not possible because of its limited size, although the principle has been accepted even by the European Commission.[10]

To overcome the likely Germany's and Northern euro area countries' opposition, at present contrary to any form of "transfer union", the resources could be allocated to single Eurozone's countries in proportion to their population or also their GDP (if the first alternative is not feasible). Rigorous checks and assessments (*ex ante*, *in itinere*, *ex post*) should be made on costs, construction times and quality of the public works. Moreover, to increase the feasibility of the proposal, the interest expenditure on the issued bonds could be – at least in the initial stage – in charge of the national budgets. The debt service could be limited, given the current low interest rates; we can assume it, in a precautionary way, to be around 2% on 20-years maturity bonds, equivalent to 10 billion euros for the whole Eurozone.[11]

We recall that "Project Eurobonds" were already proposed by Jacques Delors in the '90s. Eurobonds have been proposed more recently also by many economists and politicians (for instance Juncker and Tremonti, Prodi and Quadrio Curzio) and there are different versions (see Quadrio Curzio, 2011, Frankel, 2015). The discussion on this type of Eurobonds has recently declined because more attention has been attached to the proposed "Stability Eurobonds" (sometimes called with some other names), i.e. new bonds jointly issued by Eurozone's countries with the key aim to substitute the national sovereign debt. Also in this case there are several proposals and alternative versions. Almost all of them imply, in any case, an at least partial mutualisation of public debts. The problem is that, at present, the political conditions for risk-sharing are not satisfied, since Germany

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[9] National investments should be further encouraged through the adoption of a "golden rule", advocated by many economists on several occasions (see for instance Blanchard and Giavazzi, 2004).

[10] See the Document "A Stabilization Function" within the Roadmap set in December 2017 (see European Commission, 2017a): the proposed "European Investment Protection Scheme" could get, in the proposal, some limited grant support from the EU budget; this budget can also provide some guarantees for issuing loans to provide the stabilisation function. The principle to stabilize investments over time and to protect them (including infrastructure and skills development) in the event of large asymmetric shocks is suitable, but the hypothesised procedure is cumbersome and probably ineffective.

[11] A more specific example could be helpful: Italy, that represents 17.5% of Eurozone's economy (this is the weight in ECB's capital), should pay 1.75 billion euro of interests each year, in front of 87.5 billion euro of new investments (to be realized within 3 years).

and other core countries are requiring a risk-reduction in the first place, namely a significant reduction of the public debt-to-GDP ratios of individual countries.

Some intermediate proposals have also been made, such as the "European safe bonds", that are formed from the senior tranche of a diversified portfolio of euro area sovereign bonds, but do not imply risk sharing[12], since a common warranty only applies to the new bonds issued at the European level (see Brunnermeier et al. 2016, Pagano, 2017). Many other more specific and (in some cases) radical proposals – such as a new Ministry of Finance of the Eurozone (supported also by the French President, Emmanuel Macron) or a new European Treasury (or also a "European Fiscal Institute" that could be an evolution of the European Stability Mechanism) – have been made within the discussion of more general reforms of the EU (and Eurozone's) governance (see among others Bénassy-Quéré and Giavazzi, 2017 and European Commission, 2017b).[13] Some possible reforms of the Eurozone are currently under discussion (for example following the Euro Summit of March 23, 2018, and preliminary proposals on EU budget 2021-28).

While waiting for the more general, but difficult, reforms of euro's architecture, that should try to make the monetary union more complete (including the introduction of a significant Eurozone's budget if we want the euro to survive)[14], we think that macroeconomic policy should be quickly made more expansionary, by means of the proposed market-financed euro area large investment plan. Notice that Eurobonds would be issued only to finance the (common) euro area investment plan *and not* to substitute national public debts, for which individual countries would still be fully accountable. As we have argued above, this plan not only would improve the economic and social situation, but it could also make national sovereign debts more sustainable thanks to the improved growth prospects and the reduction of interest rates. These positive effects will be formally shown in the theoretical model presented below.

3. The stability and sustainability conditions for public debt

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[12] This is also a drawback of the proposed instrument, since as Minenna (2017) puts it: "The lack of risk-sharing therefore leaves the door open for spreads to widen again in times of stress". A limited moral hazard is instead implied by the PADRE (Politically Acceptable Debt Restructuring in the Eurozone) plan, in which each Eurozone member's debt is reduced by the securitisation of its own share of ECB seignorage (see Paris and Wyplosz, 2014).

[13] European Commission (2017a), following the well-known Report of the Five Presidents of 2015, has triggered deep discussions but also some critiques (see for example Marelli and Signorelli, 2017c).

[14] Most of the proposed reforms have been discussed in Chapter 7 of Marelli and Signorelli (2017a).

Following Della Posta (2018), let us set the stage for the analysis of the effects that can be expected from the adoption of a euro area investment plan. The continuous time variation of the public debt-to-GDP ratio ($\frac{db_t}{dt}$) in the hands of the private sector can be described as follows:[15]

$$\frac{db_t}{dt} = -s_t + (i - g)b_t. \qquad (1)$$

The term s_t refers to the structural primary public surplus-to-GDP ratio at time t, given by the difference between government revenues and non-interest government expenditure. The variable i indicates the nominal interest rate on public debt and g is the GDP rate of growth, that for the time being are both assumed to be constant. Variable b_t is the ratio between the existing public debt and GDP at time t, so that the term $(i - g)b_t$ is the growth-adjusted service on the debt as a ratio of GDP.[16]

For public debt to be stabilized, it must be that $\frac{db_t}{dt} = 0$. When that is the case, Equation (1) becomes, then: [17] [18]

$$s^* = (i - g)b^*, \qquad (2)$$

where the symbol * refers to the long term, steady state value of the variable on which it is applied. Any value of b^*, such that (2) is satisfied, will imply a stabilization of the private debt in the

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[15] Della Posta (2018) considers the more general equation:
$\frac{db_t^P}{dt} = -s_t - m_t - f_t + (i - g)b_t.$

In the equation above, $\frac{db_t^P}{dt}$ is the time variation of the public debt-to-GDP ratio which is held by the private sector, the variable $m_t = \frac{db_t^M}{dt}$ is the time variation of the public debt-to-GDP ratio which is held by the central bank, expressing then central bank's monetary solidarity (namely a situation in which the central bank is willing to play the role of lender of last resort by injecting money in order to prevent the growth of public debt-to-GDP in the hands of the private sector) and f_t is the financing coming from a possible source of federal solidarity like the European Stability Mechanism (ESM). He also shows how is the stability condition reported above obtained. Equation (1) above ignores both m_t and f_t by assuming them as equal to zero.

[16] The baseline of the simple model that we are using can be traced back to Domar (1944), Arestis and Sawyer (2008) and Hein and Detzer (2015). A similar model, although to address different questions, is also adopted by Della Posta (2017a) and Della Posta (2017b). Della Posta (2016) also studies the stability condition of public debt when analyzing the euro area crisis within a speculative attacks model.

[17] See also Buiter (1985) and Bohn (2008).

[18] See also the stability condition assumed by Bagnai (2018) and Nuti (2018), who ignore the role played by the interest rate and by the risk premium. They follow De Grauwe (2016). Since they refer to the overall budget surplus or deficit, without distinguishing between primary deficit and service on the debt, their equation becomes: $s + ib^* = d^* = gb^*$, where d^* is the overall steady state budget deficit or surplus.

hands of the private sector, so as to avoid a public debt crisis.[19] Of course, if $g > i$, then the public debt-to-GDP ratio in the hands of the private sector would be decreasing, so that even a given primary public deficit-to-GDP ($s_t < 0$) might be fully compatible with a stable privately held public debt-to-GDP ratio. As it appears clearly from (2), the stability of the privately held public debt is under the control of both the fiscal and the monetary authority. The fiscal authority controls the primary surplus-to-GDP ratio, s, and the monetary authority (that may not necessarily be domestic, as in the case of the euro area) controls (at least partially) the interest rate on public debt, i. The latter, however, as we will discuss more thoroughly below, depends both on the reference rate, $\bar{\imath}$, chosen by the monetary authority itself and – even more significantly - on the risk premium required by the private sector.

The equation above says that what matters for public debt stability is not just the size of the public debt-to-GDP ratio (on which the euro area crisis literature has focused its attention), but also the interest rate, the GDP growth and the possibility to run the primary surplus which is necessary in order to repay it, s^*.[20]

A more general public debt-to-GDP *stability* condition, however, is the following:

$$s \geq s^* = (i - g)b^*. \qquad (3)$$

Equation (3) might suggest that in the absence of any constraints, a government would always be able to choose s in such a way that the stability of the ratio between public debt and GDP in the hands of the private sector is granted.[21] The public debt-to-GDP ratio will even decrease if $s > (i - g)b^*$. In that case, the reduction of b might also reduce i because of the possibly resulting lower default risk (Corsetti *et al.*, 2013, De Grauwe and Ji, 2013). Moreover, according to some authors, a sufficiently large primary surplus may also increase g, because the reduction of i would spread from

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[19] It should also be noted, as observed by De Grauwe (2016), that a stabilized public debt-to-GDP is a necessary but not sufficient condition for avoiding the collapse of public debt. As a matter of fact, Collignon (2012) argues explicitly that a solvent but illiquid government, which is therefore incapable to have access to financial markets, may still be forced to default by a self-fulfilling speculative attack that pushes up the risk premium and the interest rate on its debt.

[20] As Della Posta (2018) recalls, the role played by the interest rate in stabilizing public debt had received a quite significant attention in the past. Pasinetti (1981, 1997), for example, referred to the concept of 'fair interest rate' meaning an interest rate that would allow the easy repayment of public debt by preserving the intertemporal distribution of income between borrowers and lenders.

Needless to say, when the interest rate decreases so as to reach its zero lower bound, the central bank becomes powerless, and some additional tools have to be devised, as all central banks in the world have been doing in order to face the crisis hitting their respective countries by adopting the so-called unconventional monetary policies.

[21] The role of the fiscal surplus in stabilizing public debt is also considered explicitly by Collignon (2012), who introduces a fiscal policy reaction function to public debt, as resulting from EMU fiscal rules.

the public to the private sector, thereby increasing investment (Corsetti *et al.*, 2013), and the lower future expected taxes resulting from the lower b might stimulate the consumption of the private sector (Giavazzi and Pagano, 1990, 1996). Both moves, namely a lower i and a larger g, would make the right side of equation (3) flatter, thereby determining a higher critical level for the overall public debt level granting the stability of the public debt in the hands of the private sector. This is not our view, as we are going to argue in what follows.

3.1 Fiscal austerity and its effects on GDP growth and interest rates: the "fiscal multiplier effect", the "wealth effect", the "fiscal sustainability effect"

Della Posta (2018) discusses the effects of fiscal austerity on GDP growth arguing that, contrary to what suggested above, GDP growth may become negative after a fiscal contraction for at least two reasons.

The first one is that fiscal austerity depresses the economy through the standard Keynesian multiplier, which is characterized by a value greater than 1 (Krugman, 2010, Blanchard and Leigh, 2013). This can be called the "fiscal multiplier" effect.

The second suggests that when reducing public debt, the "wealth effect" on both consumption and investment decreases, thereby depressing the economy (Lerner, 1943 and 1948, Arestis and Sawyer, 2008, Eisner and Hwang, 1993, Ackley, 1951).

Both the "fiscal multiplier" and the "wealth" effect lead to conclude that a fiscal contraction may not be the right way to follow in order to solve a crisis.

A possible, simple way to represent the positive effect on GDP growth (g) by the fiscal multiplier and the wealth effect of a fiscal expansion realized through higher investments (I), then, can be expressed as follows:

$$g = \bar{g} + \delta I, \tag{4}$$

where $\bar{g}$ is the exogenous GDP growth that would obtain independently from a growth enhancing investment plan and δ is the parameter expressing the sensibility of GDP growth to investment.

Still Della Posta (2018) referring to Tamborini (2015), considers the possibility that the primary budget surplus (still as a ratio of GDP), s^*, which is required in order to stabilize the public debt-to-GDP ratio, b^* (for any given value of i and g) may go beyond the possibilities of the

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domestic economy, namely that the primary surplus-to-GDP ratio that a government can run meets an upper limit, that we indicate with $\bar{s}$.

In order to have a *sustainable* public debt-to-GDP ratio, then, the following *sustainability* equation needs to be satisfied: [22]

$$\bar{s} \geq s \geq s^* = (i - g)b^* \tag{5}$$

The IMF identifies the issue of sustainability with "a situation in which a borrower is expected to be able to continue servicing its debts without an unrealistically large future correction to the balance of income and expenditure" IMF, 2002, p. 4).

The main point made by Tamborini (2015) is that the larger is the primary surplus which is required for debt stabilization, s^*, the larger the fraction of market participants sharing the belief that it will be getting closer to the maximum level that a country can reasonably stand from a social point of view, $\bar{s}$. In turn, such a widespread belief that reduces market's heterogeneity, increases the risk premium on public debt and the interest rate to service it. As Tamborini (2015) shows, this implies that the larger s^*, the larger the interest rate, i, will be, so as to provide an explanation for the interest rate convex non-linearity identified by De Grauwe and Ji (2013).[23] The effect highlighted by Tamborini (2015) can be defined as "fiscal sustainability" effect.

As already mentioned above, the interest rate can be thought as being composed by a benchmark risk-free interest rate (the reference interest rate that is fixed by the central bank), $\bar{\iota}$, and by a risk premium component. The resulting interest rate parity can be expressed, then, as in Eq. (7) in Tamborini (2015):

$$i = \frac{1+\bar{\iota}}{1-p} - 1 \tag{6}$$

where $0 \leq p \leq 1$ is the probability of public debt default.

In turn, assuming that the private sector is composed by heterogeneous agents, such a probability of default would depend on the percentage of agents sharing the belief that the primary surplus required for public debt stabilization, s^*, has reached its upper feasibility limit, $\bar{s}$.

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[22] Notice that while Equation (3) refers to a *stability* condition, Equation (5) refers to a *sustainability* condition.
[23] Della Posta (2017b) describes the model proposed by Tamborini (2015) in full detail.

The probability of public debt default, then, depends also on the degree of uncertainty as to its sustainability. We can plausibly assume that the higher is the degree of uncertainty, the higher is the heterogeneity of market expectations, in which case there is neither a large or prevailing fraction of market participants who think that $\bar{s}$ is low, nor a large or prevailing fraction thinking that it is high.

Following Tamborini (2015), it can be assumed that the expected upper feasible limit for the primary surplus is normally distributed and has a given mean and standard deviation. This means that when s^* increases, the percentage of market participants who think that it has reached the feasibility limit $\bar{s}$ will also increase. The probability of default, then, varies with the difference between $\bar{s}$ and s^*. In particular, the risk premium (and the interest rate with it) will decrease when the difference between the two variables increases. A larger difference implies that agents' expectations of public debt default will become less homogenous and therefore less shared. So, the reduction of the market belief of public debt instability (thanks to the reduction of s^*) will induce a reduction of the risk premium on the interest rate. Such a variation implies a higher level of sustainable public debt.

From what precedes it can be concluded, still following Tamborini (2015), that the probability of default can be considered as determined by the cumulative distribution function of $\bar{s}$, so that the higher s^* is the closer to 1 such a cumulative distribution function is, namely the larger the fraction of people who will believe that $\bar{s} \leq s^*$.

Eq. (6) becomes, then:

$$i = \frac{1+\bar{\imath}}{1-F(s^*)} - 1 \tag{7}$$

where $F(s^*)$ is the fraction of people according to whom $\bar{s} \leq s^*$.

An additional element, however, should be considered as affecting the risk premium on the interest rate, which is what Alcidi and Gros (2018), IMF (2011), European Commission (2014) consider. That is the risk premium that is supposed to increase when the public debt to GDP ratio exceeds a given threshold which is assumed to be risk free. In particular, the IMF (having in mind mostly emerging countries) assumes that the interest rate on public debt will increase by .04% for any percentage point of the public debt to GDP ratio exceeding 60%, while the European Commission, referring to developed European countries, considers a .03% increase in the risk premium for any percentage point of the public debt-to-GDP ratio exceeding 60%.

It should also be noted that this conclusion acknowledges the fact that it is not a high public debt *level* to induce high interest rates, but rather a high public debt-to-GDP *ratio*, so that even a high public debt level may be stable if accompanied by a similarly high GDP level.

A representation for the risk premium reflecting debt insolvency RP^{DI} can be written, then, as:

$$RP^{DI} = \gamma(b - \bar{b}) \tag{8}$$

Including such a risk premium in the interest rate arbitrage equation, Eq. (7) becomes, then:

$$i = \frac{1 + \bar{\imath} + RP^{DI}}{1 - F(s^*)} - 1 = \frac{1 + \bar{\imath} + \gamma(b - \bar{b})}{1 - F(s^*)} - 1. \tag{9}$$

Eq. (9), determining i, is the market's reaction function to the value taken by s^*, to be compared with the government's reaction function, determining s^*, given by Eq. (2) above.

Overall, then, from Eq. (2) above it turns out that a higher GDP growth reduces the primary surplus which is necessary to guarantee public debt stability, s^*, and, in turn, Eq. (9) shows that such a lower s^* plays an additional stabilizing role, due to the reduction of the risk premium on the interest rate. As a matter of fact, anything reducing s^*, by increasing $(\bar{s} - s^*)$ and the agents' heterogeneity of expectations about the unfeasibility of the sustainability condition, would reduce also the risk premium on the interest rate.

This is precisely the case resulting from a euro area investment plan, as we are going to discuss below.

3.2 A simulation of the virtuous effects on both GDP growth and interest rates of a market-financed and growth-enhancing investment plan for the euro area.

The GDP growth-enhancing effect of the share of the investment plan undertaken in each single country can be represented by Eq. (4), as already discussed above. [24]

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[24] We might even consider the positive effect on the domestic country of the investments undertaken under the Plan in the other euro area countries, but doing this would not change the qualitative analysis and we don't do that, it in order to keep the formalization at an essential level.

By considering the "multiplier effect" and the "real wealth effect" on g, namely by substituting in Equation (2) the value of g from Equation (4) we obtain:

$$s^* = [i - \bar{g} - \delta I]\, b^*$$ (10)

and we already know that by considering the "sustainability effect" on i resulting from an investment plan, namely substituting the value of RP^{DI} from Equation (8), we have Equation (9), that we are reporting again below for convenience:

$$i = \frac{1 + \bar{\iota} + \gamma(b - \bar{b})}{1 - F(s^*)} - 1$$ (9)

Simulating Eq. (9) and Eq. (10) we can analyse the case of a country with a high debt, compared to one with a low debt, the case of a country with a GDP growth rate which is relatively higher than a second one and the case in which the low growth-high debt country benefits of a growth-enhancing and market-financed investment plan.

The main idea is that the investments made possible by the market-financed emission of Eurobonds (to be agreed at the euro area level and monitored at the same level) would increase GDP growth. This is already enough to improve the degree of sustainability of the existing (national) public debt, as reflected by the negative component $-\delta I$ in Eq. (10).

A further stabilizing effect, though, emerges from the reduction of s^*, which increases the difference between $\bar{s}$ and s^*, thereby favouring the reduction of the interest rate on public debt by increasing the agents' heterogeneity as in the mechanism described by Tamborini (2015).

However it is possible to envisage up to two additional stabilizing effects from the adoption of a publicly announced growth enhancing investment plan. As a matter of fact, on one hand it might reduce agents' heterogeneity and on the other hand it might reduce the penalization that agents assign to public debt deviations from the stability target of 0.6.

This implies that the adhering countries would be helped in the consolidation of their public debt by both the particularly favourable credit conditions (resulting from the reduction of the risk premium on interest rates), and the self-equilibrating mechanism resulting from a higher GDP growth.

Our simulations show clearly the different stability area of a country characterized by a relatively high public debt and a relatively low GDP growth with respect to the one of a country characterized by opposite features.

As shown in Figure 1, a high debt /low growth country (as represented by $b = 130\%$, $g = 0\%$, and assuming $\mu = 7\%$ and $\sigma = 3\%$) [25] will enjoy a sustainable public debt as long as the primary surplus and the interest rate granting sustainability do not exceed respectively the values of approximately 6.2% and 5.8%. The steady state values of s^* and i are respectively about 3.5% and 3.7%.

Government and market reaction functions for a high debt/low growth country
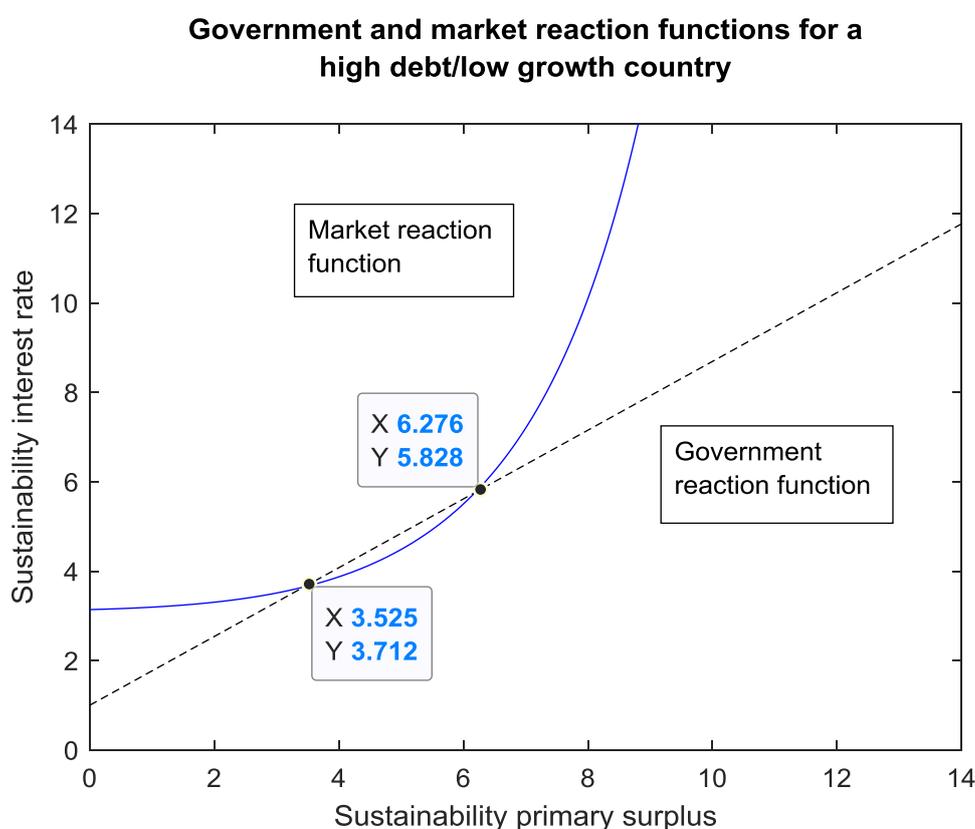
Figure 1

On the contrary, a low debt/high growth country (as represented by $b = 60\%$, $g = 2\%$, and assuming still $\mu = 7\%$ but a lower $\sigma = 2\%$, reflecting a lower degree of uncertainty compared to the previous case – although this is not an essential point and it does not change the qualitative results

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[25] Tamborini (2015) considers a mean of the distribution of the sustainable primary surplus of 7%, with a standard deviation of 2%, which is the assumption we will make when dealing with the case of a low debt/high growth country.

we will obtain), enjoys a government's reaction function which is both shifted to the left, namely characterized by a higher intercept (this is due to the higher GDP growth), and steeper than in the case with a higher public debt-to-GDP ratio.

In such a case, the stability region becomes wider and the country gets a steady state equilibrium which is characterized by values that are $s^* = 0$ and $i = 1\%$. It also enjoys a stability area that includes values for both the interest rate and the primary surplus that are much higher than in the case analysed before, as it is easy to see from Figure 2.

Government and market reaction functions of a low debt/high growth country
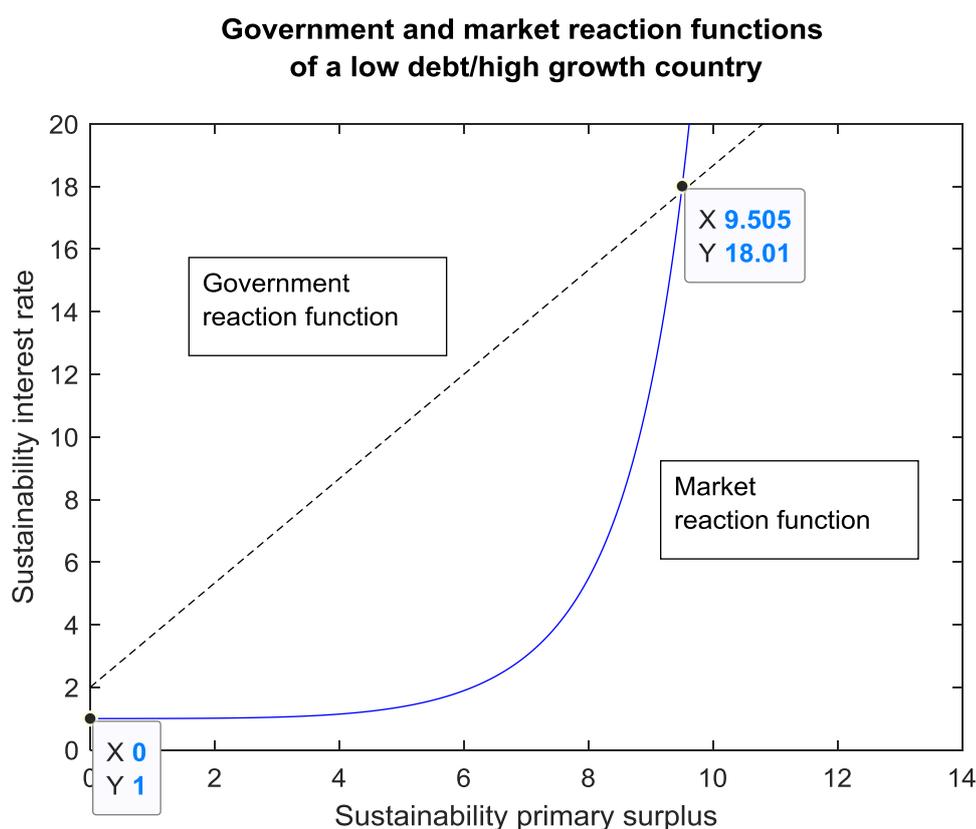
Figure 2

The difference between the two cases can be seen clearly in Figure 3, from which it appears the much wider stability area in the virtuous case of low public debt and large GDP growth (in which case stability is granted by values of *i* and *s** that are lower respectively of 18% and 9.5%, as shown in Figure 2) compared to the opposite one (in which case stability is granted by both values of *i* and *s** approximately lower than 5.8% and 6.2%, as shown in Figure 3).

It should be observed that the values of the parameters that we have used for our simulation show that a low debt/high GDP growth country reaches stability even with a zero primary surplus in

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correspondence with an interest rate required by the market (1%) which is lower than the one that the government would be willing to stand (2%). This means that there might well be room for running a budget deficit. It is tempting to apply such a conclusion to the case of Germany, where a more expansionary fiscal stance and the resulting higher domestic absorption would also help adjusting the current account imbalances characterizing the euro area.

**Government and market reaction functions for both
a high debt/low growth and a low debt/high growth country**
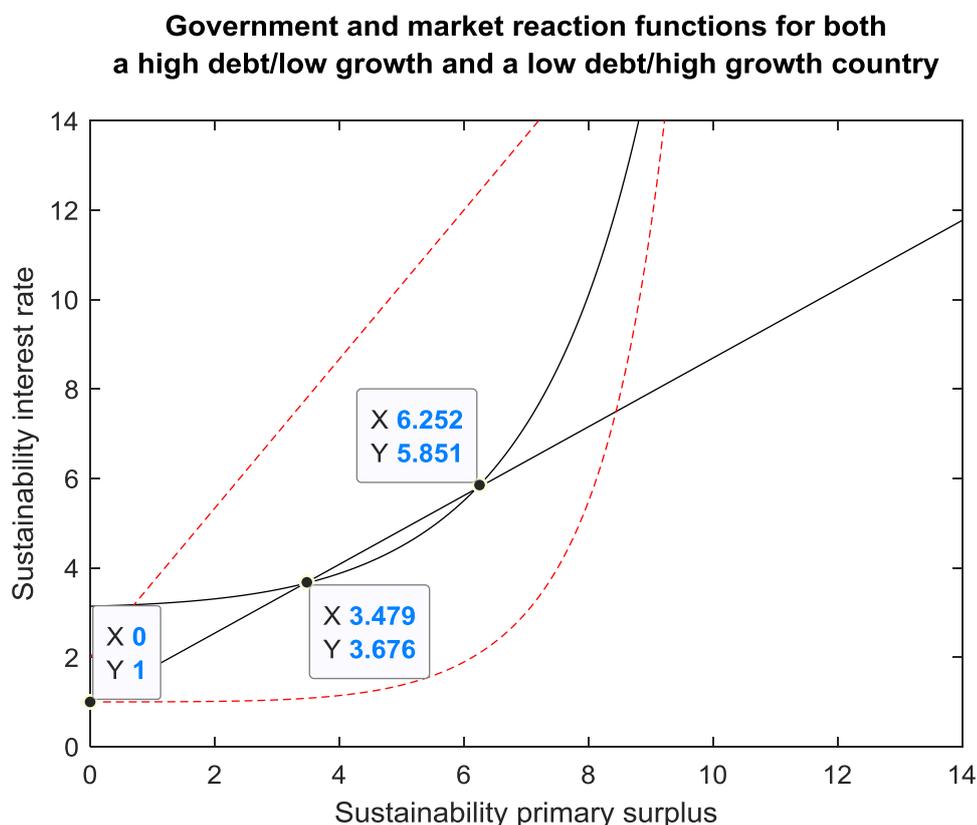
Figure 3

It is possible to see the effects of an investment plan on a high debt/low growth country by considering Figure 4, where it is assumed that the overall effect of the investment plan increases GDP growth by 1%. As a result, the government reaction function shifts to the left, thereby enlarging the stability area. The equilibrium sustainability primary surplus and interest rate move respectively from 3.4% to 1.7% and from 3.6% to 3.3%. The region of sustainability is also enlarged significantly: it is granted for values of $s*$ and i respectively of 7.1% and 7.5%, compared to the case without investment plan of 6.2% and 5.8%.

Stabilizing effect of a growth enhancing investment plan for a high debt/low growth country
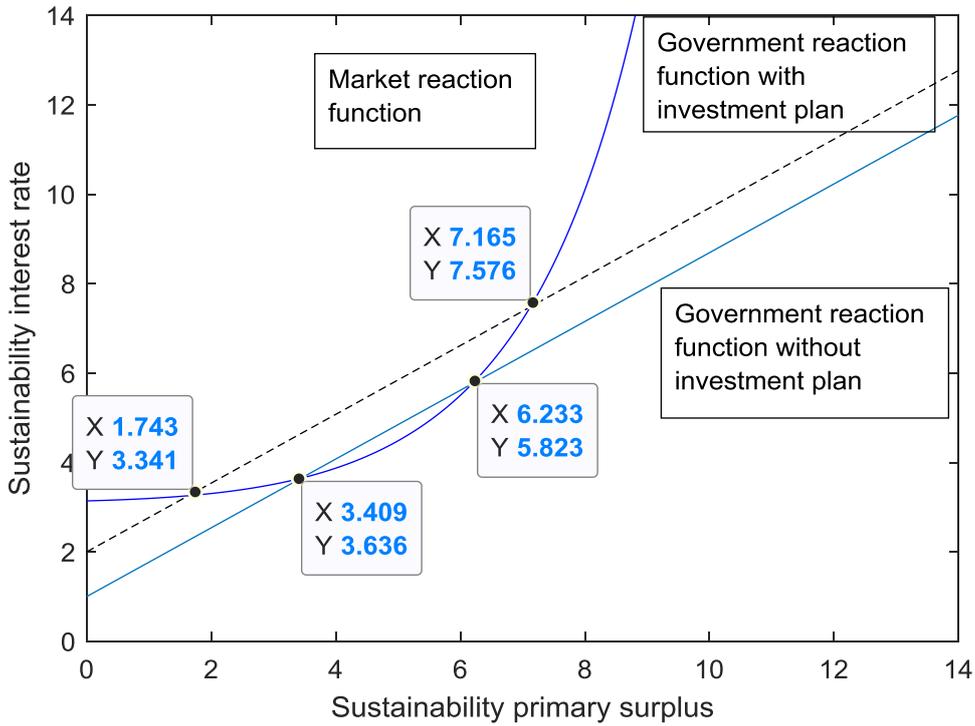
Figure 4

It is possible to envisage, however also an additional effect played on the market reaction function and producing respectively its flattening and its rightward shift. As a matter of fact, a publicly announced investment plan may increase confidence and reduce the degree of market heterogeneity (we are considering in our simulation a reduction of the standard deviation of the feasible primary surplus from 3% to 2%, so as to bring it to the level of the low debt/high GDP growth case – but again, let us stress that this is not necessary to obtain our qualitative results). Moreover, the adoption of a coordinated euro area market plan, might reduce the market sensibility to public debt-to-GDP divergences from the 60% stability level, what we indicated with the symbol γ in Eq. (8) (we are considering a rather conservative and reasonable reduction from a value of 0.03% to a value of 0.02%). Also in this second case, such a modification can contribute to increase the stabilizing effect of an investment plan, that would be there, however, even without these two additional likely effects.

The result of both the leftward shift of the government reaction function and the rightward shift of the market reaction function as a result of a publicly announced market financed and growth enhancing investment plan, then, would be an even more significant reduction of the steady state

public debt-to-GDP sustainability interest rate (from about 3.6% to 2.4%) and primary surplus (from approximately 3.5% to 0.5%), and an enlargement of the sustainability region, as shown clearly in Figure 5.

Further stabilization of an investment plan, resulting from a higher credibility shifting the market reaction function rightwards
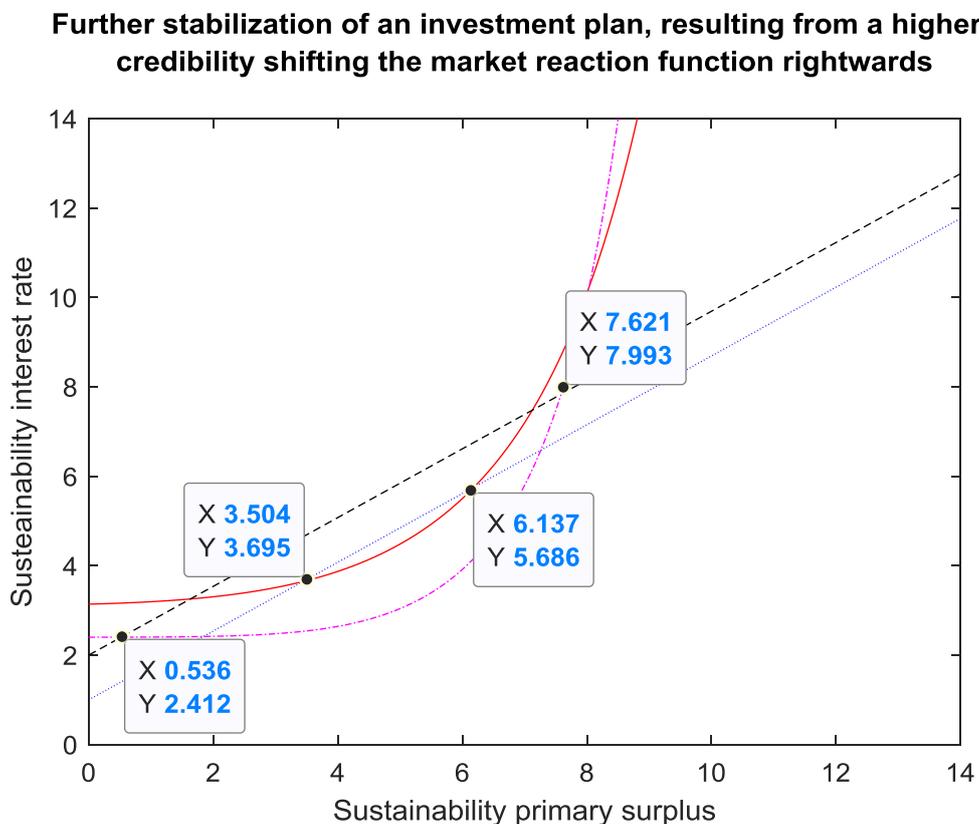
Figure 5

Let us stress once more that the investment plan we are proposing would not imply any direct commitment of euro area or EU countries to rescue high indebted countries. It would just mean to create the conditions for some growth enhancing and interest rate reducing policies that would also indirectly favour the solution of the high public debt. The investment projects will be monitored by euro area or EU countries, so the solidarity mechanism that such a plan implies would only be limited to this new level of euro area debt[26], that would increase GDP growth at the national level and would also favour the stabilization of the existing public debt without implying directly any role of lender of last resort for EU countries.

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[26] As already mentioned in Section 2, the euro area investment plan could allocate the new investments to individual countries in proportion to their GDP. Moreover, the service of such a debt could be paid by individual countries.

In other words, the risk for participating countries would remain on paper. This would be the case if an external institution centred around the European Commission were created, through which Northern euro area countries would supervise the quality of the market-financed investment plans. Northern euro area countries, then, should realize that the umbrella provided by the euro area would be a costless way for them to keep making a still significant part of the gains that they have been making so far (especially in terms of the contribution given by positive net exports to the aggregate demand on their domestic production).

Doing otherwise would imply giving up the large financing opportunities that could be easily channelled from the world financial markets to the euro area countries that are more in need of them.

Solidarity, then, does not necessarily imply financing with domestic tax-payers' money the investment undertaken by a "foreign" country: it could just mean to facilitate or simply not to hinder the world market financing possibilities that would make possible the economic development of countries belonging to the same economic and monetary area and that, as such, cannot be simply dubbed as "foreign".

Della Posta, Marelli and Signorelli (2019) point out that the investment plan described above will have a positive effect not only on GDP growth, on interest rates and on public debt-to-GDP ratios, as discussed above, but also – and maybe even more importantly, thanks to the democratic consensus that they would be able to gain - on the fight against the current wave of populism - along the lines of what suggested by Rodrik (2018) and Stiglitz (2017) – and in the end on the perspectives themselves of the success of EMU and potentially of the EU. As a matter of fact, the policies of fiscal austerity discouraged euro-enthusiasts and increased the disaffection towards Europe of a large share of (mainly southern) European citizens. As for the citizens of northern euro area countries, they should realize that the true choice they are confronted with is not between accepting growth-enhancing policies of the type we have discussed above or not accepting them, but rather between the former and the high probability of a breakup of the euro area, since over time no country will accept to remain in a union which imposes more costs than the benefits it provides.

4. Concluding remarks

We have illustrated the deep impact of the long crisis that affected many Eurozone's countries in the last decade. The long stagnation and weak recovery were also caused by the wrong

or delayed policies by the EU institutions. The rate of growth has been very slim and in some countries the real product is still below the pre-crisis levels. We have documented that the key cause has been a collapse in aggregate demand (especially in investment), so structural policies are not sufficient to reinforce economic growth and something should be done to counteract the excessive austerity of previous years.

Thus, we have discussed the effects of the implementation of a euro area, market-financed growth-enhancing investment plan. In using the framework of an old model proposed initially by Domar and adapted to represent the institutional setup of the euro area, we have focused on the stabilizing effects of such an investment plan. As a matter of fact, the latter would increase GDP growth and through this channel would also improve the financial conditions in the Eurozone. In particular, it will relax the constraint on the primary surplus that would be necessary to guarantee public debt stability of individual countries, thereby reducing the risk premium and exerting a further stabilizing effect on the interest rate.

The plan will not only augment GDP growth, both in the short-run (aggregate demand stimulus) and in the long-run (supply-side effects), but – by gradually improving the social situation – it will also lessen the opposition toward the European integration process, making possible further reforms in the governance of the European monetary union and thus making more feasible euro's survival.

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Appendix

Table A1 – GDP growth rate in selected countries (2007-2018)

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018**
Germany	3.3	1.1	-5.6	4.1	3.6	0.4	0.1	2.2	1.7	2.2	2.2	1.7
Ireland	5.2	-3.0	-6.4	-0.3	2.8	-0.3	0.2	8.8	25.1	5.0	7.2	7.8
Greece	3.5	-0.4	-4.4	-5.4	-8.9	-6.6	-3.9	0.7	-0.4	-0.2	1.5	2.0
Spain	3.8	1.1	-3.6	0.0	-0.6	-2.1	-1.2	1.4	3.6	3.2	3.0	2.6
France	2.4	0.2	-2.9	2.0	2.1	0.3	0.3	1.0	1.1	1.2	2.2	1.7
Italy	1.5	-1.0	-5.5	1.7	0.6	-2.3	-1.9	0.1	0.9	1.1	1.6	1.1
Portugal	2.5	0.2	-3.0	1.9	-1.8	-3.3	-1.4	0.9	1.8	1.9	2.8	2.2
Eurozone	3.1	0.5	-4.5	2.0	1.6	-0.7	-0.5	1.4	2.1	1.9	2.4	2.1
U.K.	2.6	-0.3	-4.3	1.9	1.6	0.7	1.7	2.9	2.3	1.8	1.7	1.3
EU-28	3.1	0.5	-4.4	2.1	1.7	-0.4	0.0	1.8	2.3	2.0	2.4	2.1
United States	1.8	-0.3	-2.8	2.5	1.6	2.3	2.2	2.5	2.9	1.6	2.2	2.9
Japan	2.2	-1.0	-5.5	4.7	-0.5	1.8	1.6	0.4	1.4	1.0	1.7	1.1

Note: * forecasts.

Source: European Commission (European Economic Forecast. Autunm 2018).

Table A2 – Public Budget Surplus/Deficit (as % of GDP) in selected countries (2007-2018)

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018**
Germany	0.3	0.0	-3.0	-4.1	-0.9	0.1	0.1	0.6	0.8	0.9	1.0	1.6
Ireland	0.2	-7.0	-13.9	-30.4	-12.6	-8.0	-5.7	-3.6	-1.9	-0.5	-0.2	-0.1
Greece	-6.7	-9.0	-15.2	-11.1	-10.1	-8.6	-12.2	-3.6	-5.6	0.5	0.8	0.6
Spain	2.0	-4.4	-11.0	-9.4	-9.4	-10.3	-6.8	-6.0	-5.3	-4.5	-3.1	-2.7
France	-2.5	-3.2	-7.2	-6.8	-5.1	-4.9	-4.1	-3.9	-3.6	-3.5	-2.7	-2.6

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*
Italy	-1.5	-2.7	-5.3	-4.2	-3.5	-3.0	-2.8	-3.0	-2.6	-2.5	-2.4	-1.9
Portugal	-3.0	-3.8	-9.8	-11.2	-7.4	-5.5	-4.9	-7.2	-4.4	-2.0	-3.0	-0.7
Eurozone	-	-	-	-	-4.1	-3.6	-2.9	-2.5	-2.0	-1.6	-1.0	-0.6
U.K.	-3.0	-5.1	-10.8	-9.6	-7.6	-8.3	-5.8	-5.4	-4.2	-2.9	-1.8	-1.3
EU-28	-	-	-	-6.4	-4.5	-4.2	-3.2	-2.9	-2.3	-1.7	-1.0	-0.7
United States	-3.5	-7.0	-12.7	-12.0	-10.6	-8.9	-5.6	-4.8	-4.2	-4.9	-4.0	-5.8
Japan	-2.1	-1.9	-8.8	-8.3	-8.8	-8.7	-8.5	-5.4	-3.6	-3.4	-3.7	-3.3

Note: * forecasts.

Source: European Commission (European Economic Forecast. Autunm 2018).

Table A3 – Public Debt (as % of GDP) in selected countries (2007-2018)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*
Germany	63.5	64.0	72.4	80.3	77.6	79.0	76.9	74.5	70.8	67.9	63.9	60.1
Ireland	24.0	42.8	62.2	87.4	111.1	121.7	123.3	104.1	76.8	73.4	68.4	63.9
Greece	103.1	109.8	126.8	146.0	171.3	158.9	174.9	178.9	175.9	178.5	176.1	182.5
Spain	35.5	39.4	52.7	60.1	60.2	84.4	92.1	100.4	99.3	99.0	98.1	96.9
France	64.2	67.8	78.8	81.5	85.0	89.2	92.2	94.9	95.6	98.2	98.5	98.7
Italy	99.7	102.3	112.5	115.3	116.4	122.2	127.9	131.8	131.6	131.4	131.2	131.1
Portugal	68.4	71.7	83.6	96.7	111.1	124.8	128.0	130.6	128.8	129.2	124.8	121.5
Eurozone	64.9	68.5	78.3	89.8	86.4	90.8	93.1	94.2	92.1	91.2	88.9	86.9
U.K.	43.6	51.6	65.9	76.4	81.9	85.8	87.2	87.0	87.9	87.9	87.4	86.0
EU-28	57.8	60.9	72.9	78.4	81.3	84.9	87.1	88.1	86.0	84.9	83.2	81.4
United States	64.0	72.8	86.0	94.7	99.0	102.5	104.6	104.4	104.7	106.7	105.2	105.8

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*
Japan	176.6	184.6	202.4	208.2	222.3	228.6	232.8	236.1	231.3	235.6	235.9	236.2

Note: * forecasts.

*Source*: European Commission (European Economic Forecast. Autumn 2018).

Table A4 – Public investment (as % of GDP) in selected countries (2007-2018)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*
Germany	1.9	2.1	2.4	2.3	2.3	2.2	2.1	2.1	2.1	2.1	2.2	2.4
Ireland	4.6	5.2	3.7	3.3	2.4	2.0	2.0	2.2	1.8	1.9	1.8	2.1
Greece	4.9	5.6	5.7	3.7	2.5	2.5	3.4	3.7	3.8	3.5	4.4	3.5
Spain	4.7	4.6	5.1	4.7	3.7	2.5	2.2	2.1	2.5	1.9	2.0	2.2
France	3.9	3.9	4.3	4.1	4.0	4.1	4.0	3.7	3.4	3.4	3.4	3.4
Italy	2.9	3.0	3.4	2.9	2.8	2.6	2.4	2.3	2.2	2.1	2.0	1.9
Portugal	3.2	3.7	4.1	5.3	3.5	2.5	2.2	2.0	2.2	1.5	1.8	2.0
Eurozone	3.2	3.3	3.6	3.4	3.1	2.9	2.8	2.7	2.7	2.6	2.6	2.7
U.K.	2.5	3.0	3.3	3.2	3.0	2.8	2.6	2.8	2.7	2.7	2.6	2.7
EU-28	3.2	3.4	3.7	3.5	3.3	3.1	2.9	2.9	2.9	2.7	2.7	2.8
United States	3.8	4.0	4.2	4.1	3.9	3.6	3.2	3.1	3.1	3.1	3.3	3.3
Japan	3.6	3.5	3.9	3.7	3.6	3.6	3.9	3.9	3.7	3.6	3.7	3.4

Note: * forecasts.

Source: Eurostat (government gross fixed capital formation)

Figure A.1 – Long term interest rates (January 2007 – May 2018)
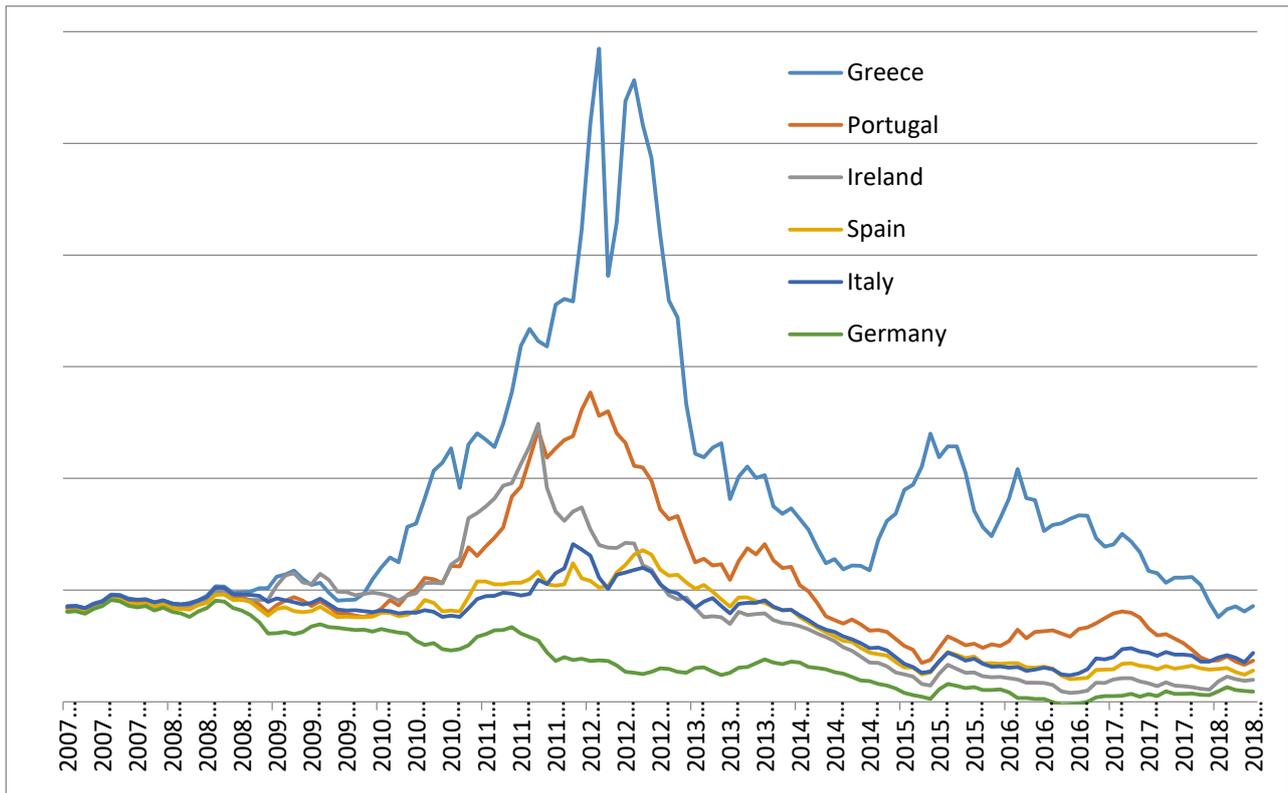
Source: Eurostat (long term interest rates as convergence criteria in the Maastricht Treaty)
Note: monthly data on annual base.